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METHOD OF REMOVING ARSENIC (III) FROM WASTE WATER [SPOSOB OCHISTKI STOCHNYKH VOD OT MYSH'YAKA (III)]

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METHOD OF REMOVING ARSENIC (III) FROM WASTE WATER

Abstract

The invention pertains to removal of arsenic from waste water, in particular to biological removal and it can be used to remove arsenic from industrial effluent.

A phosphate method of removing arsenic ions from waste water by chemical reagents by the use of which one can remove arsenic from waste water up to the maximally permissible concentrations (MPC) with the formation of a practically insoluble calcium-phosphate-arsenic complex. This method can be used effectively in the presence of the oxidized form of arsenic AS (V).

Because industrial waste water usually contains arsenic in the trivalent form, the solution prior to purification is oxidized by using pyrolusite (MnO_2), and then it is precipitated in an indissoluble complex with the use of milk of lime and phosphates [1].

A deficiency of the given method is the fact that during oxidation of the arsenic (III) with the use of pyrolusite preliminary dilution of the arsenic-containing waste water is required to a concentration of 150-200 kg/l of AS (III) with its initial concentration in the waste water of 1.0-1.5 g/l of As

[1] Numbers in the margin indicate pagination in the foreign text.

(III), that is the indicated method does not allow one to purify the waste water to the required norms in the case of a high content of arsenic ions. Moreover, the oxidative columns with pyrolusite must periodically be regenerated with sulfuric acid, because during their use the pyrolusite loses its oxidative properties, which require additional operating expenses.

The method of biological purification of waste water to remove arsenic that is closest in technical solution and attainable result employs iron bacteria Leptothrix ochracea, Leptothrix crossa, Galionella ferrugined with simultaneous introduction of metallic iron and regenerator in the form of sodium sulfide. /2

The existing method allows one to purify waste water that contains up to 4 mg/l of arsenic after a four-day contact of the microorganisms with a specific volume of water at temperature of 18-22°C [2].

The role of the microorganisms in this method is indirect because the method is based on oxidation by iron bacteria of Fe (II) to Fe (III) and chemical deposition of the arsenic by the latter.

With arsenic content greater than 4 mg/l the existing method does not assure the degree of purification necessary to reach the MPC.

The aim of the invention is to improve the purification degree.

The established goal is reached by the fact that in the method of waste water purification to remove arsenic (III) by oxidation to arsenic (V) with subsequent treatment with phosphates and milk of lime, the oxidation is carried out by microorganisms Pseudomonas putida and Alcaliqueues gutrophus.

The microorganisms are aerobic, gram-negative, non-spore forming bacilli, which are capable of using as a source of carbon a broad spectrum of organic substances. Therefore, mixing the industrial waste water with a small quantity of domestic waste water, yeast production discharges, brewery discharges and other discharges, which contain organic substances, has a stimulating effect on the growth of microorganisms, because they can be used as a source of energy and nutrition various organic compounds. There should be no danger that the microflora of domestic discharges might suppress the growth of arsenic-oxidizing bacteria, because ordinary saprophytic microflora does not have resistance to high concentrations of arsenic and quickly dies.

A distinctive feature of Pseudomonas putida is its tolerance for reduced temperatures and a capability of growth in the 3-30°C temperature range. A culture of bacteria Alcaligenes eutrophus can actively grow and oxidize arsenic in a broad pH range -- from 6 to 105. Microorganisms are capable of oxidizing arsenic, which

contains As (III) with pH of 7-0 in a solution in concentration of 1.5-3.0 g/l without diluting the solution.

During passage of the solution over a layer of microorganisms, adsorbed on a solid carrier, the trivalent arsenic is completely oxidized to the pentavalent form and then precipitates in a practically insoluble precipitate with phosphates and calcium.

In order to purify very acidic discharges (pH 1-3) with the use of microorganisms one must first alkalize the water in the 7-9 pH range, but this is not an economical process, because in order to obtain solid solutions of arsenic, one must always perform further alkalization of discharges to a pH of 11-12. Therefore, after the solution passes through a column with microorganisms one must only add a deficient quantity of alkali to a pH of 11-12.

This oxidation column with arsenic oxidizing microorganisms can function steadily with identical activity level, because the adsorbed cells easily proliferate and do not require additional handling for their regeneration.

Thus, the purification process can be carried out without interruption, or even periodically in a temperature interval from 3 to 30°C.

Example 1. Montmorillonite clay, one which microorganisms have been adsorbed, is added to nine oscillating flasks with

medium and arsenic. Next, to three flasks one adds a culture of arsenic oxidizing bacteria Pseudomonas putida, strain 18; to three flasks one adds a culture of Alcaligenes eutroptus, strain 280; and to the three last flasks one adds a mixture of cultures of Ps. Putida strain 18 and A. eutrophus, strain 280. Thus, it was discovered that the arsenic oxidation rate with a mixture of cultures is two times greater than with separate strains with identical biomass of microorganisms.

Example 2. Microorganisms Ps. Putida strain 18 and A. eutrophus, strain 280 are adsorbed on montmorillonite clay, porolon porous clay or claydite filler. Next the microorganisms with adsorbent are placed in the oxidation column with working volume of seven liters.

Waste water that contains 1.5-2.0 g/l of As (III) with pH of 7-8 is passed through a column at the rate of 2.5 l/day. In order to intensify the process one adds to the column 15 g of organic substance in the form of sugar beet pulp. The solution, after passing through the column, contains completely oxidized arsenic (pentavalent), which then is precipitated by phosphates and milk of lime. /3

The column operated continuously for thirty days at constant rate and in this period the vitality of the microorganisms was not suppressed.

The advantage of the method is the possibility of purifying undiluted waste water that contains up to 1500-2000 mg/l arsenic.

CLAIMS

Method of purifying waste water to remove arsenic (III) by oxidation to arsenic (V) with subsequent treatment by phosphates and milk of lime, characterized by the fact that in order to improve the purification degree the oxidation is carried out by microorganisms Pseudomonas putida and Alcaligenes eutrophus.

Information sources considered by the examining board:

1. USSR Author's Certificate No. 558,004, Cl. C 02 C 5/02, 19770121.

2. USSR Author's Certificate No. 722,854, Cl. C 02 C 5/10, 19780503.